Methodological Advances in Investigating L2 Writing Processes

Révész, Andrea; Michel, Marije

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State of the Scholarship

INTRODUCTION

Andrea Révész*

University College London

Marije Michel

University of Groningen and Lancaster University

The last three decades have seen a significant advancement in describing and understanding the processes involved in second language (L2) writing (for recent reviews, see Cumming, 2016; Polio, 2012; Roca de Larios, Nicolás-Conesa, & Coyle, 2016). Much of the existing research has been cognitive in orientation and concerned with capturing the online behaviors of L2 writers (i.e., directly observable characteristics of the writing process such as pausing) and the cognitive operations that underlie L2 written production (e.g., planning, linguistic encoding). In the cognitive paradigm, the motivation for studying L2 writing processes comes from two main sources. First, research into L2 writing processes is important for theory-building purposes. When constructing and assessing theoretical models of L2 writing, it is not sufficient to look at the linguistic product of the composing process. To avoid the risk of construct underrepresentation (Norris & Ortega, 2003), it is also crucial to provide evidence about the behaviors of L2 writers and the cognitive activities underlying those behaviors. Second, it is believed that information about what L2 writers do when they compose a text can yield useful insights for L2 instruction and assessment. There is increasing evidence, for example, that understanding the processes in which good L2 writers engage may help identify what strategies may be beneficial to teach (e.g., Olson & Land, 2007; van Gelderen, Ootsdam, & van Schooten, 2011). Knowledge about how observable writing behaviors relate to underlying cognitive processes could also help diagnose sources of writing difficulty, and thereby enable educators to adjust instruction to better meet their students' needs. Last but not least, research into L2 writing processes can also provide instructors with insights into the language learning potential of writing, that is, how the act of written production may foster cognitive processes,

*Correspondence concerning this article should be addressed to Andrea Révész, UCL Institute of Education, University College London, 20 Bedford Way, London, WC1H 0AL, UK. E-mail: a.revesz@ucl.ac.uk

which are assumed to facilitate L2 development (Manchón & Roca de Larios, 2007a). In short, L2 writing process research may inform L2 instruction and assessment by advancing our understanding of both the learning-to-write and writing-to-learn dimensions of L2 writing (Manchón, 2011).

Over the past decades, a variety of methods have been employed to explore L2 writing processes, with a view to informing cognitive models of writing and generating insights for L2 instruction. The aim of this special issue is to highlight methodological innovations in the field. We also intend to demonstrate how adopting new data-collection technologies and approaches to data analysis and combining these in innovative ways can generate new and more valid information about the L2 writing process and open up new avenues for research. This focus on methodological issues appears timely not only in the context of L2 writing research but also against the backdrop of increasing interest in and growing awareness of methodological considerations in the larger field of L2 research (Marsden & Plonsky, 2018). This introduction provides a brief review of previous theoretical and related empirical work on L2 writing processes; discusses the potential of various methods, both more traditional and novel, to gain insights about the cognitive activities of L2 writers; and finally introduces the five empirical studies included in the special issue with a focus on their methodological contribution.

THEORETICAL PERSPECTIVES AND EMPIRICAL INSIGHTS ON THE L2 WRITING PROCESS

Much of the research into L2 writing processes has been inspired by cognitive models originally developed to explain the process of first language (L1) writing. Initially, Hayes and Flower's (1980) model was mainly selected as the theoretical basis for L2 investigations. Based on research in cognitive psychology, this model describes writing as a recursive, nonlinear process of problem solving, including three subprocesses: planning, which entails the generation of ideas, organization, and setting of goals; translation, involving the conversion of plans and thoughts into linguistic form; and reviewing, which comprises editing and reading the evolving text. These processes interact with the task environment, defined by the task instructions and the text written so far; and draw on information retrieved from the writer's long-term memory, such as stored plans for writing and knowledge of the topic, audience, grammar, and writing conventions. This complex set of operations is coordinated and controlled by the monitor. Informed by this model, a principal focus of L1 and L2 writing research was to identify differences in the behaviors and cognitive processes of expert and novice writers. Researchers studying L2 users (e.g., Cumming, 1989; Raimes, 1987; Victori, 1999) revealed that, similar to L1 users, experienced L2 writers plan longer and make more elaborate plans than their less experienced counterparts. Also, experts revise more, and focus on both global and local issues, whereas novices tend to be more concerned with local problems.

The distinction between skilled and less skilled writers is also central to Bereiter and Scardamalia's (1987) model, a theoretical framework that was adopted by some ensuing studies into L2 writing processes. Bereiter and Scardamalia distinguish a basic knowledge-telling approach, in which writers share their knowledge about a topic through direct retrieval of content from long-term memory, from an expert knowledge-

transforming approach, in which writers do not only access ready-made information from memory to tell knowledge but also shape and revise it to correspond to their rhetorical functions in the emerging text. The few L2 studies that were conceptualized in terms of Bereiter and Scardamalia's model confirmed that, depending on their level of expertise, L2 writers indeed demonstrate knowledge-telling and knowledge-transforming behaviors to a differential degree (e.g., Cumming, 1995; Danzak, 2011).

A shared feature of Flower and Hayes' (1980) and Bereiter and Scardamalia's (1987) models is an emphasis on higher-level reflective thinking processes, with the implication that L1 and L2 writing processes are similar in terms of setting goals and generating content (Galbraith, 2009). Neither of the models, however, addresses the difficulties that may arise in the process of converting ideas into language, and how these might influence the content-generation process. Subsequent cognitive models of writing have placed greater emphasis on the cognitive operations involved in translating ideas into text, in light of empirical evidence demonstrating that text production is often an effortful and nonautomatic process, especially for L2 writers (Roca de Larios, Murphy, & Manchón, 1999). In their later work, Hayes and colleagues (Chenoweth & Hayes, 2003; Hayes, 1996, 2009) include more elaborate descriptions of linguistic encoding processes and assume more active interaction between translation and planning.

Likewise, Kellogg's (1996) cognitive model, the theoretical basis of several recent L2 investigations (e.g., Kormos, 2011; Révész, Kourtali, & Mazgutova, 2017; Révész, Michel, & Lee, 2017), provides detailed predictions about linguistic encoding processes, including lexical retrieval, syntactic encoding, and expression of cohesion. These are assumed to interact in a recursive manner with the processes of planning content and organization, execution (i.e., production of text through motor movements during handwriting or typing), and monitoring of the developing text. There is increasing empirical research indicating that L2 cognitive writing processes are well aligned with the writing stages and substages posited by Kellogg (Révész, Kourtali, et al., 2017; Révész, Michel, et al., 2017). However, less empirical evidence is available about when the stages and substages proposed occur, and how long they last during the writing process. In general, studies of writing processes have tended to examine the overall frequency and proportion of cognitive activities without considering when the cognitive activities occurred (Rijlaarsdam & van den Bergh, 1996), even though writing is assumed to be a dynamic and recursive process both in Kellogg's and earlier models of writing. The few L2 investigation that have addressed the temporal dimension of writing indicate that, indeed, L2 writers engage in specific writing processes and subprocesses to a differential extent at various writing stages (e.g., beginning, middle, end), and the distribution of cognitive activities over time depends on the writers' level of proficiency (Barkaoui, 2016; Manchón & Roca de Larios, 2007b; Roca de Larios, Manchón, Murphy, & Marín, 2008; Tillema, 2012) and the type of writing task (Barkaoui, 2016).

The dynamic nature of writing is also captured in Galbraith's (2009) model of writing. This model challenges classical writing models (Bereiter & Scardamalia, 1987; Flower & Hayes, 1980) on the grounds that they treat writing exclusively as a top-down, explicit process, where text production is assigned the passive role of translating previously formed ideas and manipulating existing content (Galbraith, 2009). Instead, inspired by connectionist models and empirical evidence that writing can affect thought, he proposed a dual-process model, which entails two types of processes: knowledge retrieval and

knowledge constituting. As in the classical models, the knowledge-retrieval processes are explicit and involve retrieving existing knowledge from long-term memory, which may be reorganized in working memory to meet rhetorical aims. Knowledge-constituting processes, however, are implicit and can produce new content and ideas through synthesis, potentially leading to novel understandings during text production. According to Galbraith, effective writers rely on and can switch between these two conflicting processes. L2 writers, however, are expected to rely less on the knowledge-constituting system, given that they can produce shorter bursts of language due to their limited L2 proficiency (Chenoweth & Hayes 2003), and bursts are the basis for developing new ideas through implicit memory. Galbraith's model received some empirical confirmation in the context of L1 writing research (Galbraith, 1999; Galbraith, Torrance, & Hallam, 2006), but little is known about its applicability to L2 writing.

Several more recent writing models (e.g., Galbraith, 2009; Hayes, 1996; Kellogg, 1996, 2001) posit a key role for working memory. Drawing on Baddeley's (1986) multicomponent framework, Kellogg made explicit predictions regarding how the various components may affect the writing process. According to Baddeley's original model, working memory comprises three main components: a central executive and two domain-specific subsystems: the phonological loop and the visual-spatial sketchpad. In Kellogg's view, the central executive or supervisory system, is involved at all stages of the writing process, as multiple operations are happening in parallel. The phonological loop, which is responsible for the temporary retention and manipulation of verbal information, is called upon during translation and monitoring as these stages involve the processing of verbal material. The visual-spatial sketchpad, specialized for storing and handling visual and spatial information, is required when writers engage in planning and monitoring. Planning content involves generating prelinguistic ideas that often entail images, whereas monitoring necessitates maintaining an image of where different parts of the text are located. The small number of studies that have examined whether working memory is implicated in L2 writing confirmed a role for various aspects of working memory. Kormos and Sáfár (2008) and Adams and Guillot (2008) observed a positive link between phonological short-term memory and text quality, and Révész, Michel, and Lee (2017) found that phonological short-term memory, the visual spatial sketchpad, and executive functioning were all related to several aspects of text quality or type of online writing behavior in the direction predicted by Kellogg (1996, 2001).

Working memory, a construct interrelated with the processes of attention and awareness, is also implicated in theoretical perspectives that have been adopted as a basis for research exploring the language learning potential of writing, the consideration that L2 writing can serve as a venue for language learning (Manchón & Roca de Larios, 2007a). This line of research has mainly been conceptualized drawing on Schmidt's (1994, 2001) Noticing Hypothesis and Swain's (1985, 1995) Output Hypothesis. Schmidt claims that attention is a necessary condition for L2 development; and noticing, defined as focal attention accompanied with awareness, further enhances the chance of new L2 features being encoded and then learned. Building on Schmidt's work, one tenet of the Output Hypothesis is that producing output induces learners to notice gaps in their interlanguage knowledge. In Swain's view, output production additionally provides a platform for testing hypotheses about the L2, and can serve as a point of departure for metalinguistic reflection. Reflecting these theoretical ideas, writing has been proposed as

an optimal platform for developing knowledge of and gaining control over the use of L2 form-meaning mappings (Cumming, 1990; Manchón & Roca de Larios, 2007a). By now, the presumed language learning benefits of writing have received much empirical confirmation (Manchón, 2011), with most studies employing the concept of language-related episode (LRE; Swain & Lapkin, 1995) as a unit of analysis to operationalize awareness. Previous studies in this area, however, have predominantly focused on collaborative writing (e.g., Storch, 2005); less research is available about the extent to which language learning opportunities arise during the process of individual writing.

INVESTIGATING L2 WRITING PROCESSES: METHODOLOGICAL ISSUES AND POSSIBILITIES

With the aim of describing L2 writing processes and thereby informing L2 writing models and instruction, researchers have employed various methods, ranging from traditional techniques such as verbal reports, questionnaires, and interviews to the more recent use of state-of-the-art tools such as keystroke logging and eye-tracking. In reflection of current methodological practices and new developments in the field, the remainder of this section focuses on three techniques: verbal reports, keystroke logging, and eye-tracking.

To date, the majority of cognitively oriented research into L2 writing processes has relied on verbal reports, such as the think-aloud and stimulated recall procedures. Think-alouds, or concurrent verbal reports, involve participants in describing their thoughts while they are in the process of composing. In the area of L2 writing, this technique has been employed to examine a number of topics, including the cognitive processes in which writers engage (e.g., Manchón, Roca de Larios, & Murphy, 2009), links between the writing process and product (e.g., Van Weijen, Van den Bergh, Rijlaarsdam, & Sanders, 2008), the use of L1 in L2 writing (e.g., Wang & Wen, 2002), and the strategy use of L2 writers (e.g., Yang & Shi, 2003). Although studies using think-alouds have contributed considerably to our current understanding about L2 writing processes, the technique has been criticized because the act of thinking aloud may lead to reactivity and thus jeopardize construct validity. In other words, concurrent verbalization of one's thoughts while composing may alter the writing process and/or the resulting writing product, leading to incorrect conclusions. The potential danger posed by reactivity has been scrutinized in several studies of writing (e.g., Yang, Hu, & Zhang, 2014; Yanguas & Lado, 2012), but so far, the findings are inconclusive (Polio & Freedman, 2017). Another possible threat associated with concurrent verbal reports concerns veridicality, that is, the incapability of verbal reports to capture all of the participants' thought processes. Indeed, there are individual differences in the ability to think aloud (Barkaoui, 2011), and some cognitive processes are not accessible to awareness and thus remain unavailable for verbalization (Polio & Freedman, 2017).

Like think-alouds, stimulated recall protocols are also widely used to investigate L2 writing processes. This technique intends to tap the thoughts that participants had during writing by employing *a posteriori* recall sessions (Gass & Mackey, 2016), using some tangible reminder (e.g., the text produced, video- or screen-recording of the writing process) to stimulate participants' recall. L2 researchers have utilized this technique, for example, to explore changes in writing processes over time (Sasaki, 2004), individual

differences in writing processes (Bosher, 1998), strategies adopted in L2 writing (DeSilva & Graham, 2015), and the impact of task complexity manipulations on writing processes (e.g., Révész, Kourtali, & Mazgutova, 2017). As compared to concurrent verbalization, stimulated recall has the advantage of posing reduced threat to reactivity, but it carries a higher risk in terms of veridicality. Due to memory decay, it is likely that participants cannot provide fully accurate and complete reports of the cognitive activities in which they previously engaged. However, a careful implementation of the technique can arguably mitigate the influence of potential issues with veridicality (Gass & Mackey, 2016).

Probably due to the limitations associated with verbal reports, more recently researchers have begun to use keystroke logging, alone or in combination with verbal reports, to capture real-time L2 writing processes. Keystroke-logging programs record the writers' keystrokes and mouse movements without interrupting the composing process, and the resulting log files provide detailed information about concurrent writing processes, such as fluency, pausing, and revision behaviors (Lindgren & Sullivan, 2019; Van Waes, Leijten, Lindgren, & Wengelin, 2015). Although a relatively new technique, a few L2 studies have already employed keystroke logging to examine the effects of proficiency (Barkaoui, 2016), task type (Barkaoui, 2016; Spelman-Miller, 2000), and task complexity (Révész, Kourtali, & Mazgutova, 2017) on L2 writing behaviors; to compare the behaviors of L1 and L2 writers (Stevenson, Schoonen, & De Glopper, 2006; Thorson, 2000; Tillema, 2012; Van Waes & Leijten, 2015); and to assess longitudinal changes in L2 writing behaviors (Spelman Miller, Lindgren, & Sullivan, 2008). Being unobtrusive and providing real-time data, keystroke logging appears to offer several benefits over verbal protocols. Data obtained with the help of keystroke logging, however, has the disadvantage of affording no direct evidence about the cognitive operations of L2 writers. In addition, keystroke logs, unlike verbal protocols, provide no information about the reading activities in which L2 writers are involved.

A way to address this limitation is to combine keystroke logging with eye-tracking methodology. This technique can be used to record the writer's moment-to-moment eye gaze or eye fixations they make while they are engaged in composing the text. The assumption underlying eye-tracking methodology is that the focus, order, and length of eye fixations reflect individuals' attentional allocation in processing visual information (Reichle, 2006). Thus, the joint use of eye-tracking and keystroke logging allows for recording not only physical text production processes but also viewing behaviors during writing. While eye-tracking has been employed in several L1 writing studies (e.g., de Smet, Leijten, & Van Waes, 2018; Johansson, Wengelin, Johansson, & Holmqvist, 2010), this technique is just beginning to be applied to investigate L2 writing processes. In one of the first studies to use this technique, Révész, Michel, and Lee (2017) examined L2 writers' viewing behaviors while pausing, with a focus on whether their eye fixations during pauses remained within the word, clause, sentence, or paragraph preceding the point of inscription. The researchers also triangulated the eye-tracking data with recordings of keystroke logs and stimulated recall comments. Similarly, Gánem-Gutiérrez and Gilmore (2018) used eye-tracking methodology together with digital screen capture and stimulated recall protocols to study L2 writing processes. In both studies, the combination of methods allowed for obtaining a more complete picture of the writing process than employing any of the methods alone would have afforded. Indeed, it would appear that a promising approach to overcoming the limitations of the various

methods is to use multiple data-collection techniques and triangulate the data obtained, thereby increasing the likelihood that valid inferences are made. This is also the approach that has been employed by several contributions to this special issue, as explained in the following section.

THE SPECIAL ISSUE

The articles in this special issue either adopt new technologies, employ novel analytical approaches, and/or combine new and more traditional methods in innovative ways to examine the L2 writing process. The articles included demonstrate how the use of novel techniques and analytical procedures, alone and/or together, can foster and lead to a more in-depth, detailed, and valid understanding of the L2 writing process.

The first empirical study by López-Serrano, Roca de Larios, and Manchón employed concurrent verbal protocols to explore the language learning potential of individual argumentative writing tasks. The methodological contribution of this research lies in the development of a theoretically motivated and empirically based coding system to categorize language-related reflections of L2 writers. Drawing on the idea that L2 writing is an important site for language development (Manchón, 2011), the specific aim of López-Serrano, Roca de Larios, and Manchón was to identify and characterize the processes in which individual writers engage when composing L2 texts. The dataset comprised transcriptions of 21 EFL writers' think-aloud protocols, which was coded for LREs (Swain & Lapkin, 1995). Then, the LREs were further reconceptualized and categorized according to five dimensions: linguistic focus, resolution, strategy use, depth of processing, and orientation. López-Serrano, Roca de Larios, and Manchón also provide examples for the various coding categories based on the dataset, but the primary outcome of the study is the coding scheme, which can be used in future research to conduct in-depth analyses of the LREs that emerge during individual L2 writing and to classify them in terms of the potential for language development they may involve.

The next contribution by Barkaoui examines L2 writers' pausing behaviors as a window into writers' cognitive processes. Barkaoui begins with a comprehensive literature review of previous work on pausing during writing, which is followed by an extensive introduction to keystroke logging methodology, highlighting both the advantages and challenges associated with the technique. In the second part of the article, Barkaoui illustrates how pausing data can be collected, analyzed, and interpreted. In doing so, he relies on keystroke-logging data of 68 L2 writers of English, who performed a version of the integrated and independent TOEFL iBT writing task. The study demonstrates the ways in which keystroke-logging data can be utilized to investigate the influence of factors such as proficiency, keyboarding skills, task type, and stage of writing (beginning, middle, end) on pause frequency, duration, and location. Barkaoui found that high-proficiency students tended to pause less often than low-proficiency writers. Interestingly, pauses were also found to be longer initially, probably to allow writers to plan their text in greater detail. Finally, the initial stage elicited fewer but longer pauses on the integrated task, possibly because writers were rereading the input text at the beginning of this task type.

Another empirical study by Leijten, Van Waes, Schrijver, Bernolet, and Vangehuchten also used keystroke logging to tap L2 writing processes. The researchers

compared the writing performance of 280 university students, who engaged in source-based writing in both their L1 Dutch and L2 English. The participants were asked to write texts drawing on three different sources: a report, a web text, and a newspaper article. Using the software Inputlog (Leijten & van Waes, 2013), the resulting keystroke logs were analyzed for frequency and duration of pausing and source use at five different stages of the writing process. Confirmative factor analysis showed three components to be relevant to describe source use in L1 and L2 writing: (a) initial reading time, (b) interaction with sources, and (c) the degree of variance in source use throughout the writing process. Regardless of whether the students wrote in their L1 and L2, those who produced high-quality texts spent most of the first interval consulting the source texts. Then, this initial stage was followed by an intensive writing time, during which more skillful writers frequently switched between the text and sources for short periods. In the final stage, hardly any source use was logged for successful writers, as they focused on revising their texts.

The next empirical contribution is among the first studies to employ eye-tracking methodology in combination with keystroke logging in L2 writing research. The study by Chukharev-Hudilainen, Saricaoglu, Torrance, and Feng demonstrates a sophisticated method of investigating writing disfluencies and the nature of associated cognitive processes, using a tool they had developed to record time-aligned logs of eye gazes and keystrokes. The participants were 24 Turkish L1 writers, who completed two writing tasks, one in Turkish and one in L2 English. The study utilized largely automated analyses to examine interkey intervals or pauses at different locations (e.g., within word) and their relationships to viewing patterns (e.g., lookback distance). The results confirmed that the participating writers were significantly slower in their L2 than L1. In line with previous research (e.g., Révész, Michel, et al., 2017), the researchers also found that, irrespective of the language used, pauses at smaller linguistic units were associated with shorter lookback distances, and pausing at larger linguistic units was related to longer lookback distances. Unexpectedly, however, writers proved faster at starting a new clause in the middle of a sentence in their L2 than L1, followed by longer pauses within the new clause. Writers also consulted the previous sentences more often when writing in their L2. Chukharev-Hudilainen, Saricaoglu, Torrance, and Feng interpreted this behavior as a potential threat to text quality, given that the co-occurrence of a clause-initial pause and a lookback beyond the current sentence likely indicates that the L2 writer's attention was diverted away from the emerging linguistic unit.

The last empirical study in the special issue by Révész, Michel, and Lee used eye tracking together with keystroke logging and retrospective verbal reports to examine the revision and pausing behaviors of L2 writers and the cognitive processes underlying them. Thirty advanced-level Chinese writers of English completed a version of the IELTS Academic Writing task 2 while their keystrokes were logged and viewing behavior was recorded. In addition, a subset of the participants took part in stimulated recall interviews immediately after task performance. The study found that pausing at larger textual units was more likely to be related to lookbacks further in the text and higher-order writing processes. By contrast, pauses at lower textual units were linked to shorter lookbacks and lower-order writing processes. The results also revealed that, before revising their text, participants had most often viewed the text that they later altered or their eye gazes had remained off the screen. More revisions focused on language- than

content-related issues, but when the revisions involved larger textual units, the difference in the number of language- and content-focused stimulated recall comments was smaller. In general, Révész, Michel, and Lee found that the triangulation of the three data sources enabled them to obtain a fuller and more valid picture of the writing process than using a single data source would make possible.

The epilogue by Galbraith and Vedder first considers the theoretical frameworks within which previous work on L2 writing processes has been situated. Then, the researchers provide a synthesis of the empirical studies included in the special issue, highlighting promising methodological advances and associated challenges. Galbraith and Vedder conclude that the methods described in the special issue promise to equip researchers with tools that will enable a deeper understanding of the complex cognitive processes involved in L2 writing.

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